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ABSTRACT

This packet contains two science learning activities that can be used in agricultural education courses. The first activity, "Using Ethanol as a Solvent," is intended to help students describe the characteristics of a solvent, to enhance student observational skills dealing with physical changes, and to demonstrate the acid or alkaline nature of materials. The second activity, "Determining Color Trait Dominance," is intended to help students determine the coat colors resulting from several pairings of genetically different mice. The lesson plans for the activities consist of the following elements: agricultural subjects and science principles included in the lesson, agricultural applications, student objectives, activity length, group size, vocabulary, materials required, instructional strategies and procedures (overview and results), key questions, and evaluation. One or two references are given for each activity, and each includes a data record and observation sheet. (KC)

AGRICULTURAL EDUCATION SCIENCE ACTIVITY
Nos. GGEB 1-2

Ohio Agricultural Education Curriculum Materials Service
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Using Ethanol as a Solvent

Agricultural Subjects

- Genetics/Genetic Engineering/ Biotechnology
- Products Processing
- Crop Production

Science Principles

- Solute versus solvent identification
- Organic extraction
- pH identification (acid or base)

Agricultural Applications

Water is known as the universal solvent; that is, many types of chemicals dissolve in water. This is very important for life and industry. However, there are some chemicals which will not dissolve in water. This is important for industry and commerce. On the other hand, **ethanol** mixes not only with water, but also with industrial chemicals. Therefore, this 'grain alcohol' is an excellent choice to bridge the gap between water and many chemicals important to industry, but unable to mix with water.

Ethanol is used as a solvent to extract organic oils such as soybean, citrus, and flower. This is important to the perfume, flavoring, and oil industries. In addition, when dissolving sulfur, ethanol is more effective than water. Therefore, ethanol can be used to clean coal contaminated with sulfur, thus preventing sulfur dioxide and acid rain.

This experiment shows ethanol's ability to dissolve chemicals which are useful to man. Phenolphthalein, a pH indicator (acid or base), is used in this experiment. This chemical indicates pH ranges of 8.3 or higher. It is widely used in tests where pH monitoring is important (e.g., water quality, soil, and material tests).

Student Objectives

- To describe the characteristics of a solvent.
- To enhance student observational skills dealing with physical changes.
- To demonstrate the acid or alkaline nature of materials.

Activity Length

- Within one class period.

Group Size

- This activity can be conducted as a class or in small groups (2 to 3 students).

Vocabulary

ethanol	solvent	dissolve
phenolphthalein	solute	acid
pH	soluble	base

Materials Required

EQUIPMENT

1. 3 glass beakers - 200 to 400 ml
2. 2 eyedroppers
3. Stirring rod
4. Spatula
5. Graduated cylinder

CHEMICALS

1. Ethanol - 100 ml
2. Distilled water - 200 ml
3. Phenolphthalein indicator (solid) - 2 portions of 0.3 gm each
4. Lime powder
5. White vinegar

Instructional Strategies and Procedures

■ **Overview:** Mix distilled water and phenolphthalein in beaker 1. Observe and record the results. Next, mix ethanol and phenolphthalein in beaker 2. Again, observe and record results. Now, place distilled water in beaker 3. Add a few drops of the ethanol-phenolphthalein mixture in beaker 2 to the water in beaker 3; stir. Now add a small amount of lime powder to the mixture in beaker 3; stir. Observe and record results. Finally, add a small amount of white vinegar to the mixture in beaker 3; stir. Record your final observations.

1. Number the empty beakers 1 through 3.
2. Fill beaker 1 with 100 ml of distilled water. (Use the graduated cylinder to measure the water as accurately as possible.)
3. Now add one portion (0.3 gm) of phenolphthalein to the distilled water in beaker 1 (see Figure 1).
4. Using the stirring rod, stir the water and phenolphthalein. Observe the results and record them on page 4. Discard the mixture and rinse the stirring rod with water.
5. Next, fill beaker 2 with 100 ml of ethanol.
6. Add the remaining portion (0.3 gm) of phenolphthalein to the ethanol in beaker 2 (see Figure 2).
7. Stir the ethanol and phenolphthalein mixture with the stirring rod. Observe the results and record them on page 4. DO NOT discard this mixture. Rinse the stirring rod with water.
8. Now place 100 ml of distilled water in beaker 3.
9. Using an eyedropper, add approximately 3 drops of the ethanol-phenolphthalein mixture in beaker 2 to the water in beaker 3. Stir this mixture; rinse the stirring rod.
10. Next, using the spatula, scoop up a small amount of lime powder (just enough to cover the spatula tip). Add this to the water, ethanol, and phenolphthalein in beaker 3. Stir this mixture; rinse the stirring rod.
11. Observe the results and record them on page 4.
12. Now fill the second eyedropper with white vinegar. Add to the mixture in beaker 3 and stir (see Figure 3). If necessary, repeat this step until a change occurs. Observe the changes and record them on page 4.

■ **Results:**

1. The phenolphthalein (indicator) will not mix with the distilled water.
2. The phenolphthalein is soluble in ethanol.
3. The water and ethanol/phenolphthalein mixture will turn red when lime is added (pH above 8.3).
4. The water, ethanol, phenolphthalein and lime mixture will turn clear when enough vinegar is added (pH below 8.3).

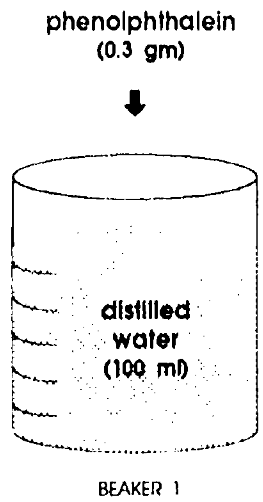

Figure 1. Contents of beaker 1

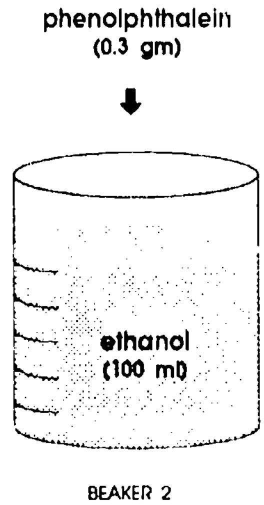

Figure 2. Contents of beaker 2

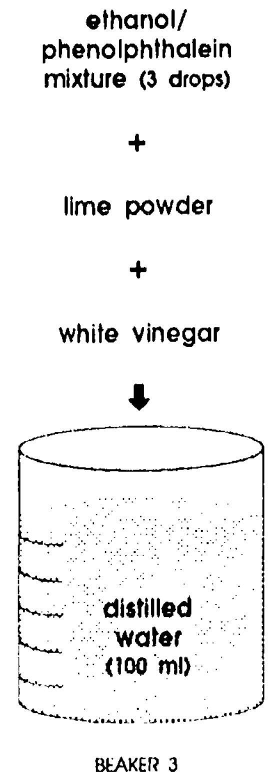

Figure 3. Contents of beaker 3

Key Questions

1. What happened when the phenolphthalein was added to the distilled water?
2. What happened when the phenolphthalein was added to the ethanol?
3. What physical changes took place when the lime was added to the ethanol-phenolphthalein mixture?
4. What physical changes took place when the vinegar was added to the ethanol-phenolphthalein-lime powder mixture?
5. Phenolphthalein is colorless when mixed with a material having a pH below 8.3; however, it has a color when mixed with a material having a pH above 8.3. With this in mind, how can phenolphthalein be used to identify the general nature of lime? Of vinegar? How can phenolphthalein be used to identify other materials?
6. What would happen to the ethanol-phenolphthalein mixture if the ethanol were allowed to evaporate? How can we apply this factor to industry and other applications for ethanol?

Evaluation

- Ask students to write a conclusion based on what they have observed.

Bibliography

1. Ouellette, R.J. *Introductory Chemistry*. 2nd edition. Harper and Row, 1975.
2. *Standard Methods for the Examination of Water and Waste Water*. 4th edition. American Public Health Association, 1976.

Demonstration submitted by Ohio Task Force on Agri-Science.
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DATA AND OBSERVATION SHEET

Using Ethanol as a Solvent

Name ______________________________ Date ______________ Period __________

BEAKER 1	BEAKER 2	BEAKER 3	
Distilled Water and Phenolphthalein	Ethanol and Phenolphthalein	Distilled Water, Ethanol-Phenolphthalein, and Lime Powder	Distilled Water, Ethanol-Phenolphthalein, Lime Powder, and White Vinegar

Agricultural Subjects

■ Genetics/Genetic Engineering/ Biotechnology

■ Animal Science

Activity Length

■ Ten weeks

Group Size

■ This activity can be conducted individually or in small groups (2 to 3 students).

Science Principles

■ **Genetics**: All organisms resemble their parents to a certain degree, but they also differ in some ways. These similarities and differences depend on the interaction and/or segregation of genes, environmental factors, and the occurrence of mutations.

■ **Reproduction**: Living things are able to reproduce their own kind from a part of themselves.

Agricultural Application

■ Animal growth depends on cell division; animal traits are developed according to the individual's genes. In agriculture, livestock selection is important to animal breeders. They must develop animal characteristics which are acceptable and profitable for the livestock owner. For example, selecting for animal coat color is important when marketing wool. In sheep, the white color gene dominates the black color gene, resulting in a white sheep. Therefore, agriculture students need a basic understanding of genetics in order to make wise breeding decisions.

Agricultural Education Science Activity – No. GGEB-2

Determining Color Trait Dominance

Student Objective

■ To determine the coat colors resulting from several pairings of genetically different mice.

Vocabulary

dominant	gene	genotype
recessive	heterozygous	homozygous
phenotype	sex-linked	agouti mice
mutation	gestation	

Materials Required

1. Two white male mice
2. One white female mouse
3. Two agouti female mice
4. One agouti male mouse
5. Nine polystyrene lab boxes
6. Nine small animal water bottles
7. Shredded newspaper (litter)
8. Lab chow
9. Labels
10. Paper and pen to record results

Instructional Strategies and Procedures

■ **Overview**: The mice are paired and mated. Approximately 20 days after fertilization, offspring are delivered. Record the color traits passed on from the parents to the offspring. If time permits, mate the offspring with a pair of white mice to further determine the dominant characteristics. Record observations and discuss results.

Instructional Strategies and Procedures

(continued)

Before beginning the experiment discuss basic genetic concepts. Include the following terms: homozygous, heterozygous, genotype, phenotype, sex-linked traits, and recessive and dominant traits.

1. Cover the bottoms of three lab boxes with litter. Label each box (1 through 3).
2. Mate first pair of mice (one white female and one white male). Place in lab box 1.
3. Mate second pair of mice (one agouti female and one agouti male). Place in lab box 2.
4. Mate third pair of mice (one agouti female and one white male). Place in lab box 3.
5. Record the following information on page 3: pair number and experiment starting date.
6. Each day allow animals free choice of lab chow and water.
7. Allow 20 days for gestation.
8. After birth of offspring, record the following information on page 3: offspring delivery date, number of offspring, and color of offspring.
9. After offspring mature, mate one or two offspring from each original pair with a white mouse. Prepare lab boxes and proceed as outlined in steps 5 through 8.

■ **Results**: To be determined after trial.

Key Questions

1. What are the dominant phenotypes that resulted in each pair of mice after mating?
2. Are the color traits sex linked?
3. When is it possible for recessive genetic traits to be expressed?
4. What are some of the benefits of controlling coat color in animals?

Bibliography

Cackler, William. *Livestock and Poultry Breeding*. Columbus, OH: Ohio Agricultural Education Curriculum Materials Service, The Ohio State University, 1989.

Experiment submitted by Sue Haddix, Production Agriculture Instructor, London High School, London, OH 43140.

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Null Hypothesis

■ The dominant hair coat color in this trial is white.

Evaluation

■ Ask students to write a conclusion based on what they have observed.

DATA RECORD AND OBSERVATION SHEET

Name ______________________ Date __________ Period _____

Determining Color Trait Dominance

Objective

Procedure

Observations and Results

Pair Number	Experiment Starting Date	Offspring Delivery Date	Number of Offspring	Color of Offspring

Conclusions